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Dwelling in Space Through Knowledge of Place: Building on Epistemological Understandings of the Seventeenth-Century British Atlantic

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Dwelling in Space through Knowledge of Place: Building on Epistemological
Understandings of the Seventeenth-Century British Atlantic

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Bachelor of Arts, University of Virginia, 2012

A Thesis presented to the Graduate Faculty
of the College of William and Mary in Candidacy for the Degree of
Master of Arts

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This Thesis is submitted in partial fulfillment of
the requirements for the degree of

Master of Arts

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ABSTRACT

Epistemologies of space, environment, dwelling, and the body are essential to the study of past individuals through their constructed spaces. Most important to this study is the notion that one's knowledge of the world is integral to the ways in which one dwells within it. This paper explores colonial English epistemologies of climate through an analysis of dwelling spaces of the seventeenth-century Chesapeake. I consider Early-Modern perceptions of air, temperature, and the body as vital to understanding the various ways in which colonial places were defined and shaped. Further, I employ an analytical method known as Buildings Information Modeling (BIM) to understand the implications of seventeenth-century pit house construction, investigating the ways in which individuals interact with an environment, constructing and dwelling through a particular way of knowing the world. To do so, I operationalize and expand upon Tim Ingold's concept of the "weather-world" to understand the relationship between climate and indoor space in the British Atlantic. This paper ultimately demonstrates how archaeological evidence speaks to the material ways in which people manipulate their experience of place, to not only experience the "weather-world," but shape it to fit the epistemological context that creates a 'knowledge of place'.

TABLE OF CONTENTS

Acknowledgements	ii
Dedication	iii
List of Figures	iv
I. Introduction	1
II. Air as Artifact	5
III. Humors, Body, and Weather in the British Atlantic	7
IV. Buildings Information Modeling (BIM): Methodological Briefing	12
V. Analysis: Chesapeake Pit Houses	14
a. Jamestown	16
b. Flowerdew Hundred	23
c. Martin's Hundred	27
VI. Discussion	30
VII. Conclusions	33
References	37

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LIST OF FIGURES

1. Tidewater Ground Temperatures	16
2. Caribbean Ground Temperatures	16
3. Jamestown blacksmithing/bakery structure (View A)	19
4. Jamestown blacksmithing/bakery structure (View B)	19
5. Jamestown BIM – Summer, Oven Not in Use	20
6. Jamestown BIM – Winter, Oven Not in Use	20
7. Jamestown BIM – Summer, Oven in Use	20
8. Jamestown BIM – Winter, Oven in Use	20
9. Excavation of 44PG82	24
10. Profile Bisection Drawing of 44PG82	24
11. Flowerdew Hundred BIM – Hypothetical Summer Above	26
12. Flowerdew Hundred BIM – Summer Below Ground	26
13. Flowerdew Hundred BIM – Hypothetical Winter Above	26
14. Flowerdew Hundred BIM – Winter Below Ground	26
15. Martin's Hundred BIM – Winter Extremes	29
16. Martin's Hundred BIM – Summer Extremes	29
17. Martin's Hundred BIM – Summer Extremes Comparative	29
18. Martin's Hundred BIM – Hypothetical Summer Above	29

Introduction:

"[a]ll the inhabitants of the worlde are fourmed and disposed of suche complexion and strength of body, that every [one] of them are proportionate to the Climate assigned unto them."

– Richard Eden, 1561 (Chaplin 2001:120)

"We live submerged at the bottom of an ocean of air."

– Evangelista Torricelli, 1644 (Middleton 1963:22)

Epistemologies of space, environment, dwelling, and the body are essential to the study of past individuals through their constructed spaces. As a point of departure, this paper highlights that one's knowledge of the world is integral to the ways in which one dwells within it. This study concerns dwelling spaces distant from our own, ideas of the body distant from our own, and interactions with the environment distant from own. Perhaps most distant in this study, is the physical self. To the seventeenth-century English observer, the body was seen not in present terms associated with cellular biology, but in the Galenic formulation of bodily humors, founded in Hippocratic theory and embraced within medical practice and everyday belief (Arika 2007; Kupperman 1984; Tannenbaum 2012:6-7). In a study of seventeenth-century Anglo-American perception of bodily health, historian Karen Kupperman writes, "The four elements, air, fire, earth, and water, were believed to be represented in the human body by the humors blood, yellow bile or choler, phlegm, and black bile or melancholy. Good health resulted from the proper balance of these humors, but each climate created its own characteristic balance" (1984:214). Humoral imbalance caused shifts in personality (or tempers) and accounted for all physical and mental symptoms of illness and exhaustion. With the climatic range of English colonization of the New World, from the West Indies to the

Chesapeake, New England and Newfoundland, concern for the balance and imbalance of the bodily humors transcended health, religion, foodways, and the built environment. The shift from a medieval understanding to a post-medieval understanding did not alter such systems of knowledge, as the Galenic belief in bodily humors dominated pre and post-Enlightenment understandings of the body. These seventeenth-century measures of climate, perceptions of weather, and physical notions of hot and cold created a colonial landscape shaped for and shaped by the bodily experience and fear of the temperature extremes. Such understandings would hold sway until questioned by germ theory in the nineteenth century, which largely replaced humoral belief by the turn of the twentieth century.

Directly related to the imbalance of humors, excessive heat – as experienced through a change in one’s climate – was considered to be a root cause of sickness in the New World (Kupperman 1982, 1984, 2007:158-83). An increased emphasis on empirical observation in the mid to late-seventeenth century merely confirmed this belief, as most sickness associated with heat was accompanied by burning fever, a burning stomach, and/or severe sweating. Heat itself was not seen as a transfer of kinetic energy in the seventeenth century, but a product of the physical element *fire*. The sun heated the element *air*, and the nearer one was to the sun, as the equatorial region was thought to be, the hotter the surrounding air.

Hot air was characteristic of place and referenced to specific latitudes. Seventeenth-century colonial officials took great care in observing latitude and climatic conditions in their writings, and their impacts on the English body. The climates, or “clime,” of New World regions were often understood as “in-tune” with countries sharing

the same latitude in continental Europe, and every parallel region of the earth. Climates were further determined either appropriate or inappropriate for the specific humoral balance of the English body, attributed to the climate of England, and commonly referred to as one's *constitution* or *complexion*. By mid-century, this belief of *constitution* was one of many early justifications for enslaved African labor over that of British indentured servants. While outside the scope of this particular study, such Early-modern reasoning argued that West African birthplaces were nearer in parallel climate, and thus nearer in bodily constitution – rhetoric to justify a suitability for labor in Caribbean and southern North American colonies (Chaplin 2001; Curtin 1964; Pitman 1926).

Practices in building and dress (*e.g.* Loren 2011) seem to represent two immediate responses to the balance of the English bodily constitution in the climatic flux of the Chesapeake, as were changes in foodways, alcohol, and the consumption of tobacco. Reporting on the colony of Virginia in 1650, Edward Williams observes, “Wee must not therefore conforme the nature of the Climate to our Rules, but our Rules to it, ... and in what one Climate differs from another, how the constitution of this yeare varies from the next, or the precedent, the immediocrities of heate, cold, drought, and moisture, serenity, or mists, &c.” (1650:34). Such a concern for bodily and structural acclimations was tied-up with the necessity of controlling the extremes of weather, and specifically temperature through experimentation in housing form and materials.

Understanding seventeenth-century perceptions of climate, daily engagements with weather, and the Early Modern bodily perception allows one to approach such a distant epistemological world as an input for archaeological interpretation. This paper explores colonial British epistemologies of climate through an analysis of dwelling spaces

of the early seventeenth-century Chesapeake, and the ways in which individuals interact with an environment, constructing and dwelling *through* a particular way of knowing the world. Colonial settlers did not directly transplant English dwelling spaces to a Virginian context, but employed contemporary understandings of space, airflow, and the experience of heat and cold in reference to the humoral body to produce balanced and healthy living spaces.

In this paper, I operationalize and employ Ingold's (2007; 2010; 2011) concept of the "weather-world" to understand the relationship between climate and indoor space in the seventeenth-century Chesapeake. Ingold characterizes a weather-world, "[a]s an experience of light, sound and feeling that suffuses our awareness, the weather is not so much an *object* of perception as what we perceive *in*, underwriting our very capacities to see, to hear and to touch. As the weather changes, so these capacities vary, leading us not to perceive different things, but to perceive the same things differently" (Ingold 2011:130, *emphasis original*). Revising many issues of landscape approaches, this perspective redefines the study of place within an epistemologically situated understanding of the ways in which people render domestic places meaningful and shape those places to foreground experiential characteristics. Thus, the notion of the weather-world engages not only with the landscapes on which one walks, but also the "medium" in which one lives – weather (Ingold 2007:S20). Conceiving of weather as "the lived experience of climate" (Pillatt 2012:578), this paper considers Early-Modern perceptions of air, temperature, and the body as vital to understanding the various ways that colonial places were defined and shaped. By employing Buildings Information Modeling (BIM) to better understand the implications of seventeenth-century methods of pit house

construction in the colonial Chesapeake, this study examines how contemporaneous understandings of climate, heat, and the English body influenced conditions in domestic spaces. Furthermore, through intermingling Galenic practice of bodily humors with the history of the philosophy of science and technology of dwellings, the paper provides another epistemological underpinning to the investigation of colonial people, the houses that they made, and the “ways that they knew” the natural world through their dwelling spaces.

Air as Artifact

In situating the perception of weather within its seventeenth-century context, dwelling spaces are not the end product of this study, but rather the means to understanding the cultural construction of microclimates, and how such microclimates were considered and used. This approach shifts the archaeological unit of analysis to that of the invisible, shifting not the scale of analysis *per se*, but rather the state of analysis – from solids to gases. This departure points to a different conception of *what is* an archaeological *record*, illustrating new directions for archaeological investigation and practice.

First and foremost, as it concerns the definition of archaeological records, we create a record of what is archaeological. This is done in the publication and dissemination of findings and interpretations, but it is also done more generally during the decisions made while excavating. Developments in technology allow new material evidence to be seen, shifting the boundaries of various disciplines' subject matter. Flotation, microbotanical analysis, and scanning electron microscopy (SEM) allow for

new forms of archaeological evidence, creating new sources of data at the advent and application of the tools (Hodder 2012). Thus through technology (the extension of human sensual ability) and theory (the extension of thought), we are constantly defining and redefining forms of the "archaeological record," shifting the categorical identity of what is considered "archaeological." Material deposits are certainly left by past activities, behaviors, societies, and ways of life, but the process of conceiving of this material as "archaeological," exists only within the framework of the researcher. In looking at buildings as both physical microclimate and social microcosm, it is important to return to what archaeologists study:

“Material culture is usually considered to be roughly synonymous with artifacts, the vast universe of objects used by mankind to cope with the physical world, to facilitate social intercourse, and to benefit our state of mind. A somewhat broader definition of material culture is useful in emphasizing how profoundly our world is the product of our thoughts, as that sector of our physical environment that we modify through culturally determined behavior. ... Our body itself is part of our physical environment, so that such things as parades, dancing, and all aspects of kinesics—human motion—fit within our definition. **Nor is the definition limited only to matter in the solid state. Fountains are liquid examples, as are lily ponds, and material that is partly gas includes hot air balloons and neon signs** (Deetz 1977:24–25, *bold mine*).”

In this study, a standard though arbitrarily defined square-measurement of air represents the primary unit of analysis. The human manipulation of air, through the creation of bounded space (*i.e.* a building), warrants the definition of air as artifact. This unit of analysis is perhaps more apparent below, in which a particular building form is created within the medium of negative space, constructed primarily through excavation as opposed to assembly. A pit house, as with any architectural form, is not simply a container for people and their material culture; it is an active player in physical and social

experience (Bourdieu 1973, 1977; Deetz 1977; Glassie 2000; Johnson 1993, 2010). As Hodder recently noted, “a house gathers humans and non-humans, links together for a moment matter, energy and information in useful ways (2012:9).” Such a conception of interior spaces provides a new direction, and new source of optimism for an explicit buildings archaeology. Such an approach does not accept the recording and categorization of built environments as an end, but rather as a means “to understand something of the ways of life and system of thought of their builders, owners and users” (Johnson 2010:3). Dwelling spaces are vital to understanding the dynamic intersection of people, material culture, and place. This paper concerns these intersections by investigating the ways in which people engage, understand, and manipulate natural phenomena (*e.g.* heat, air, earth) to dwell *through* a knowledge of place. Buildings are never empty, but are always containing; enclosing objects, microclimates, and people in a particular way.

Humors, Body, and Weather in the British Atlantic

In his synthesis of Atlantic World scholarship, David Armitage observes, “The attraction of Atlantic history lies, in part, in nature: after all, is not an ocean a natural fact?” (2002:11). Within such an oceanic scale, Armitage is correct in asserting that the geography of study is integral and defined, though the Atlantic common denominator must not be accepted in terms of spatial boundaries alone. However, such an observation of nature is not insignificant, particularly in regards to *a nature* as perceived in the historical past. When viewed through a Western lens, the colonial exploitation of the Atlantic basin, from the late-fifteenth century onward, existed within a series of colliding

epistemological beliefs that sought to make sense of an unfamiliar and, quite literally, New World. Early modern scientific practice, common perceptions of weather, and Galenic understandings of human anatomy shaped dwelling practices within the range of colonial environments encountered. This complicates many presentist notions that rest upon modern understandings of the human body and its relationship to the environment. The English colonization of the Chesapeake region of Virginia is one such colonial endeavor in which the archaeological record, considered with the documentary record, provides a unique understanding to the role of historical epistemology in regards to perception of natural phenomena, and by extension, dwelling within New World environments.

As recorded in the documentary record from the 1580s through the mid-seventeenth century, the reconnaissance and mapping of the mid-Atlantic concerned all observable facets of the New World from physical geography to the description of indigenous groups, much of which was carefully prefaced by the effects of differing climates upon the English body. For the seventeenth-century English individual, climate was not seen as a backdrop to colonial endeavors, but a primary obstacle for English bodies raised in English weather. Relative to one's birth and maturation in England, dramatic change in temperature was seen as a primary cause of illness, and by extension, death in the geographic mobility of colonial travel (Kupperman 1982; 1984). This belief stemmed from the understanding of the human body as consisting of four humors, generally correlated with bodily fluids, of which the particular balance determined both physical and cognitive health. Though beyond physical wellbeing, the balance of the four humors directly corresponded to the four tempers [choleric, melancholic, phlegmatic, and

sanguine], of which determined one's shifting mood and personality (Arika 2007; Tannenbaum 2012:6-7). Linking emotion (tempers) to health, extreme moods were often observed as symptoms of physical illness, treated through remedies of humor rebalance. In her exploration of Early Modern medicine and society, Mary Lindemann notes, "Standard therapies and preventives depended on readjusting perceived imbalances by siphoning off a humor that had either grown too strong or become corrupt" (2010:14). Through surgical bleeding, sweating, induced vomiting, laxatives, and the draining of wounds and lesions, early English colonists treated sickness through the redistribution of humoral fluids relative to external factors like temperature and moisture. Medical care centered around prevention through "dietary regimens" of *hot* and *cold* foods (Kupperman 1984:214), clothing appropriate to weather, heated and iced baths, control of moist and dry air, and the careful "seasoning" to new places. Forcing redistribution through surgical treatment was knowingly high-risk, and only considered a last resort after "acclimation" to new temperatures had failed.

Of greatest health concern with colonial travel was radically shifting one's climatic setting. An often-recorded ordeal, the length and horror of this correlation between sickness and mobility were scaled to the latitudinal remove from England (Chaplin 2001:117-124; Kupperman 1982; 1984; 2007; Rockman 2010). Sixteenth and seventeenth-century notions of climate were not identified through climate zones as today, but rather characterized by a specific latitude, associated with parallel weather around the world. In the first half of the seventeenth century, Virginia was typically identified as sharing a latitude and climate with Persia (Williams 1650:19), China (*ibid*, p. 20) and Spain (Smith 1612:20; Whitaker 1614), while New England with Germany

(Plantagenet 1648:20) and France (Smith 1624:210). A latitudinal description became an important preface to any characterization of place, serving to categorize and associate the physical experience of weather with a series of familiar reference points for English administrators. Publishing a pamphlet in 1649, William Bullock observes, "In that part of Virginia, where now the English inhabite, which is under the degree of 37, and part of 38, the Ayre is pleasant and wholesome, especially to those that are seated above the flowing of the Salt water (1649:4)." While period marginalia on this pamphlet disagrees with Bullock's "pleasant" description of Virginia air (Thompson 2004), his numerical identifier is of more importance here. These latitudinal points of reference were not arbitrarily recorded, but fairly common, seeking to correlate temperature with health, and organizing experiences of weather within a recordable, cartographic framework.

Climate was generically categorized by an experiential, qualitative characterization of temperature, similar to what is measured quantitatively today as a *resultant* (temperature + humidity). Shifting temperatures too rapidly was thought to imbalance one's humors, as the heating and cooling of the body was simultaneously a source of sickness and an established counteractive remedy. A key physical quality of a person was the conditioning of their humoral balance to a particular climate (Kupperman 1984). As mentioned previously, such preconditioning was commonly referred to as one's "constitution," as particular colonial climates – referring specifically to temperature – were observed to either *agree* or *disagree* with English constitutions (Smith 1612:19; Councell of Virginia 1610:14; W.C. 1613:21). England was widely considered a "temperate" climate, and one's health depended upon such temperate qualities between extremes of hot and cold. In 1613, Alexander Whitaker reported, "The aire of the

Countrey (especially about *Henrico* [present-day Richmond, VA] and upward) is very temperate and agreeth well with our bodies. The extremitie of summer is not so hoat as Spaine, nor the colde of winter so sharp as the frosts of England” (1613:39). This equilibrium in temperature was described as vital to successful colonization, and where it could not be met, strategies were created to manipulate temperature to avoid extremes of hot and cold, and more importantly, dramatic shifts between the two.

In the first three decades of settlement, the unfamiliar experience of Chesapeake weather was a central concern for both agriculture and dwelling. Buildings were quickly adapted to this new place, not only in terms of construction materials, but also more subtly through architectural modifications that mitigated foreign weather. In Edward Wingfield’s 1608 account, *Discourse on Virginia*, he observes, “... they have found the way to cover their houses now (as the Indians) with the barks of trees, as durable, and as good proof against storms and winter weather, as the best tyle; defending likewise the piercing sunbeams of summer, and keeping the inner lodgings cool enough, which before, in sultry weather, would be like stoves, whilst they were, as at first, pargetted and plastered with bitumen or tough clay” (1859:35). Two years later, a similar account from the “Councell of Virginia” observes that in Jamestown, “The houses which are built are as warme and defensible against winde and weather, as if they were tiled and slated; being covered above with strong boordes, and matted round within, according to the fashion of the Indians” (1610:20). Beyond clothing, the built environment was the most immediately manipulable element of the experience of weather, and the perceived balance between hot and cold that was distinctive of place. In several cases, English colonists borrowed directly from Virginia Indians for climatic strategy (as seen in the

above quote), and in other cases, constructed new methods for moderating temperature fluctuations. Such manipulations were inherently materialistic, either further separating the body from the elements or integrating the body closer to seasonal weather. As will be demonstrated in the pages to follow, within any given colonial context, archaeological evidence speaks to the material ways in which individuals manipulate their experience of place – whether through clothing, landscape, or the built environment – to not only experience the *weather-world*, but shape it to fit the epistemological context that creates 'knowledge of place'. To do so, one must investigate built environments as an interface between the individual and the *weather-world*, making visible the experiential qualities of dwelling space.

Buildings Information Modeling (BIM): Methodological Briefing

Architects, or more generally builders, use a variety of methods to "program" their built spaces. The conscious ability to manipulate physical space frames creative pursuits in the construction of buildings and landscapes, allowing the architect, or builder, to create places "to dwell" within in a particular way (Ingold 2000:185-8). Be it through the flow of internal movement, the ease of access to particular spaces, strategic viewsheds, or the harnessing of natural light, buildings are never divorced from their initial design, they are simply adjusted to respond to any number of physical, social, or individual desires throughout its life history. This is not a recent phenomenon, but serves as the fundamental motivation for building. An archaeologist might conceive of this characteristic as a building's underlying "intentionality," though one that has become caught up in the intentions of each new occupant's desired space. Historic buildings

studied within the present-day have typically been extensively modified, though geographic location, aspects of materiality, and reflections of original geometry often remain as approachable characteristics through time.

The digital modeling or 3D reconstruction of historic buildings and landscapes is certainly nothing new to archaeology. The method itself, with a focus on two-dimensional analytics, represents one of the prime movements, along with GIS, within the recent emergence of “digital archaeology” (Baltsavias *et. al* 2006; Evans & Daly 2006; Forte 1997; Greengrass & Hughes 2008). The creation of 3D visualizations has proven to be a powerful tool for presentation and high-resolution recording, but visualizations alone, as an end, have returned many of such archaeological studies to less-expensive historic restorations. A number of 3D visualization projects have recently moved to a more analytical research design, acknowledging the potential for working with archaeological material in X, Y, *and* Z axes of meaningful space (Frischer & Dakouri-Hild 2008). Here I propose that digital methods in archaeology step beyond reconstruction alone, taking visualization from Building Modeling (BM) to Buildings Information Modeling (BIM).

To model the internal microclimates of spaces that stood nearly 400 years ago, I have used local, historic weather data (U.S. Department of Energy 2012), the archaeologically recovered geometry and material composition of spaces (Deetz 1993; “44PG82 Field Notes”; Hume 1982; Lavin 2011; May 2011; Schmidt *et. al* 2012), and local annual ground temperatures at varying depths. I calculated building characteristics (*i.e.* internal wall/roof temperatures, ground-depth insulation performance, solar-gain, internal humidity, orientation, etc.) seasonally using a combination of OpenStudio,

Energy Plus, and Climate Consultant software packages. Seasonal results were then used as inputs for 2-dimensional section models within TAS Ambiens fluid dynamics software. Through this, I then calculated interior microclimates for pit houses as resultants – a standardized comfort measurement (in degrees Fahrenheit) that combines both ambient temperature and relative humidity. Precisely scaled data visualizations were made translucent and visualized within the geometry of their initial section drawings. Thus, using both commercially and publicly available building performance methods, along with archaeological and environmental data, the modeling of annual interior temperatures of early seventeenth-century houses can reconceptualize the archaeological understanding and methodological reach of the study of former and standing built environments. In so doing, I hope to highlight the shortcomings of a reliance upon spatial or visual analysis alone, illustrating the analytical value of interior microclimates as it concerns the manipulation of place. Through such methods, one can begin to make-visible the unseen characteristics of lived experience within dwelling space. The analyses to follow utilize a Buildings Information Modeling (BIM) approach, using data visualizations to tack back and forth between a modern, quantitative understanding of dwelling space microclimates, and the early seventeenth-century epistemological understandings of living within "the bottom of an ocean of air" (Torricelli 1644 *quoted in* Middleton 1963:22).

Analysis: Chesapeake Pit Houses

Pit houses are a global phenomenon, representing an architectural form created and recreated in every hemisphere. It is therefore vital to consider pit house forms, as

with any building, in the contingencies and contextual influences of the locations in which they are found. As an environment, places associated with pit houses around the world – as a vernacular building type – have almost all occurred above the 32° N latitude, with exceptions in a few mountains regions (Gilman 1987:541 *citing* Murdock 1967). Therefore, one must view pit house construction in the Chesapeake as influenced in part, not by climate, but the English perception of climate. In the pages to follow, I will demonstrate the relationship between the Aristotelian worldview of Early Modern English society (in terms of the body, health, and the environment) and the ways in which this historical epistemology shapes Chesapeake settlement, particularly through the built environment, and specifically pit houses, also known as “cellar houses”. This approach will operationalize Ingold's "weather-world" and refine its application to consider the role of epistemology in perceiving the environment, weather, and climate.

To preface these analyses, a brief comparison between the annual ground temperature at particular depths between the Tidewater and the Caribbean (Figures 1 & 2) reveals why the use of subterranean space (*i.e.* root cellars, cellar houses, basements, icehouses, dairies, etc.) is particularly prevalent in colonial Chesapeake landscapes, and virtually absent in contemporaneous Caribbean colonial landscapes. The angle of the earth's surface to the sun's rays defines a particularly important characteristic of place as it concerns the use of ground temperatures. Briefly put, the more raking angle of the mid-Atlantic region to the sun's rays creates a distinctive heating and cooling period with annual lags in below ground temperatures. In equatorial regions like the Caribbean, a more direct angle of the sun's rays heats deep ground temperatures at near-consistent temperatures as the ground surface itself. This difference between Chesapeake and

Caribbean ground temperatures is visualized in Figures 1 & 2. Though despite a considerable contrast, this consideration cannot be framed as determined by environment alone, but rather as an interaction between human and environment in a particular colonial context, and more importantly, a particular epistemological reality in this context.

Jamestown:

In 2006, archaeologists at Jamestown Rediscovery uncovered a fort-period (1607-1624) structure in the form of a subterranean space capped with an A-frame roof (May 2011; Lavin 2011; Schmidt 2012). Built in 1607, likely a few months after the colonists' May arrival, this below-ground structure (Figures 3 & 4) was originally constructed as a multipurpose metal-working facility, yet within two years had been converted into a baking facility with two large dug-out wall-ovens (Schmidt *et. al* 2012). Surrounded by

above-ground, earthfast buildings and given the range of material options, the question surfaces – why subterranean space for this particular anomaly of a building? It has been argued that this structure references early medieval building precedent, traveling across the Atlantic in the English colonists’ cognitive pattern book, specifically referencing the medieval *Grubenhaus* form (May 2011). Both building upon and shifting this interpretive focus, this study considers environmental and epistemological context to explore Early Modern perceptions of climate, body, and temperature as three important variables in understanding this contextually situated building type.

Originally built as a multipurpose metalworking facility, colonists met early success in producing both wrought iron bars and finished forms to send back to England, most notably in the form of small iron chisels (Lavin 2011). As economic exploitation gave way to the struggle of survival, bread ovens were installed in the interior earthen wall during Jamestown’s “starving time”. Both uses in the subterranean structure’s duration demanded the control of intense heat, manipulating extreme temperatures for the task at hand. As with the bake-oven conversion, such concerns followed a larger building trend in which European settlers were forced to develop novel solutions to the most immediate concerns of survival – warfare, starvation, exposure, and the frightening reality of fire (Carson *et. al* 2008; Graham *et. al* 2007). In a fortification constructed entirely of wood, fire – a natural element in the eyes of the seventeenth-century English observer – became one of the most immediate internal threats to the destruction of both building and body.

Common knowledge and early-seventeenth-century Natural Philosophy adhered to an Aristotelian-dominated epistemology, founded upon the idea of a universe

constructed from four elements – earth, air, fire, and water. The understood properties of these elements accepted that earth and water naturally move downward, while air and fire naturally move upward, giving the earth its spherical shape and the motion inherent in the terrestrial world (Lang 1984; Rutherford 2006). Fire, as a physical element, could be contained and controlled given the right infrastructure and counteractive balances between the remaining elements. Likewise, air was manipulable to the extent that all air, like fire, was containable and moveable. Deviating from most present-day epistemologies, nature was a manipulable medium through which one worked with, not against, to control and ensure the well-being of the body that dwelled within a particular place. The proper balance between external temperature extremes ensured the proper balance of internal temperatures controlling the constitution of bodily humors – an *a priori* notion in the early modern British Atlantic. In the case of New World colonization, as Kupperman notes, “They did not understand that global weather systems produced local phenomena and thought that local changes would produce new microclimates” (2007:163). As modeled in this analysis, archaeological investigation reveals that within such an understanding of the world, buildings did not remove one from the elements, but gave one control over them within a defined space. The built environment – argued here through Chesapeake pit houses – was both conceived of and utilized to manipulate the local conditions of a particular climate as constructed within this historically situated epistemology.

Buildings Information Modeling of Jamestown’s subterranean structure demonstrates how such a way of knowing the world was integral to English dwelling in New World environments.

Figures 3 & 4: Jamestown's subterranean blacksmithing / bakery structure. *Photos taken by author.*

Subterranean structures offered temperature control, pushing the elemental combination of heat and air to the ceiling in the summer, and physically containing fire in the winter. The materials required to enclose and insulate the intensity of heat needed in both year-round baking and blacksmithing were few in option, as earth itself provided the only immediate solution. Such a practice remained in Virginia from the second quarter of the seventeenth century through the early-twentieth century with subterranean root cellars, providing the efficient climate control needed for the preservation root crops in Virginia's winter temperatures (Carson *et. al* 1981; Gage 2009; Kimmel 1993; Samford 2007:123-137). Similarly, semi-subterranean outbuildings later provided the necessarily cool microclimates for preserving dairy products (Linebaugh 1994; Olmert 2009:93-117) through the wide-scale adoption of refrigeration in the early-twentieth century.

Beyond the insulation needed for baking and metallurgy, the insulation and preservation of the self was a comparable, if not greater, necessity in Virginia's climatic range. An analysis of the thermal dynamics and material qualities of Jamestown's

subterranean bakery structure illustrates these characteristics, providing both a cooler and more manageable space to carry out daily food production in Jamestown's sweltering summer heat, and a significantly warmer space during winter extremes.

This analysis (Figures 5, 6, 7, & 8), illustrates how depth and form were created to facilitate working conditions that mitigated temperature extremes, a primary concern for the English body. Such extremes were both dangerous to humoral balance and vital to containing the physical substance of heat within the earthen oven, fronted by a brick flue and presumably sealed while baking.

Figures 5, 6, 7, & 8: Buildings Information Model (BIM) of Jamestown bake oven facility under different conditions – heating and cooling. Top images show oven not in use, bottom show in use

When brought above ground, the same volume of enclosed space with baking and smithing activities visualized near unbearable working conditions. Above ground, with greater surface area directly heated by the sun and a lack of low-lying cool air, stagnant heat from industrial and domestic activities relied upon cross ventilation alone.

To the seventeenth-century observer, this movement of physical air removed harmful vapors and the substance of heat through gaps and openings of the building. Below ground, cool, insulated air from ground temperatures dissipated heat quickly, expelling rising heat through surface-level windows, doors, and seems. The decision to construct below ground at Jamestown appears to have largely been driven out of necessity rather than choosing a more desirable space. When analyzed above ground, this volume and heat gain under local summer conditions would have been nearly, if not, impossible to occupy at length. In the hypothetically-constructed simulation of this space (*i.e.* this same volume) above ground, extreme radiant heat ($>123^{\circ}\text{F}$) ranges the length of the structure with oven in use, with surrounding air temperature at or exceeding 110°F . When measured below-ground (as constructed; *see* figures 7 & 8), taking advantage of cool, low-lying ground temperatures, the reach of extreme oven heat is reduced by half and surrounding air temperatures drop by 5 to 10°F . Similarly, the use of thermal mass (*i.e.* walls of solid earth), traps surface heat in warming periods, releasing it in colder months, thus providing a virtually mirrored mechanism of winter warmth to its effects of summer cooling. Gilman has noted similar effects in southwestern pit houses, highlighting that “Since the ground acts as a heat sink ... stored heat in the structure walls is released back into the room. Thus, the effects of wide daily or short term temperature fluctuations are virtually eliminated” (1987:543). From this analysis, one can see that the

shift from blacksmithing space to baking space was not coincidental, but rather a solution taking advantage of fire containment strategies, thermally productive infrastructure for human interface with the element of fire, and the mitigation of seventeenth-century health concerns brought about by the body's experience of shifts in temperature extremes.

This below ground space, in little time, met the immediate needs of a starving colony. Seen over and over again in the first two decades of English settlement, old constantly became new as physical objects and spaces provided the opportunity to improve one's situation. And through such changes, one's situation increasingly shifted from the balance of budget to the immediate balance of body. As colonists cobbled together the physical spaces to adapt to their new surroundings, they in turn had to adapt to their constructed spaces, fueling a culture of constant repurposing, experimentation, and improvisation (Carson *et. al* 2008; Graham *et. al* 2007). In acclimating to the foreign Virginia landscape, in architecture and in virtually all material items, "colonists tinkered with the material limitations of an Old World strategy... (Graham *et. al* 2007:455)," as suggested with the retention of the *grubenhause* form (May 2011). Though beyond the transplanting of an English built environment, a consideration of the physical quality and necessities of life became more and more entrenched with annual experience of Virginia temperatures, and particularly through the creation of a new domestic life. Subterranean space offered early English settlers a viable solution to the limitations of unskilled labor, the limited availability of specialized carpentry tools, and the immediate need for thermally adequate sheltered space. From substantial cellar houses (Schmidt *et. al* 2012) to single-dweller, sleeping pits (Deetz, E. *et. al* 2008:17-30), subterranean space at

Jamestown went from immediate solution to Chesapeake building type within a few decades.

By the 1620s, English colonization of the Chesapeake extended well beyond the walls of James Fort, as did the use of subterranean space for dwelling year-round. In 1623, one Jamestown observer reported, “they lodged in cabbins & holes within the ground (Ancient Planters ...)” (1874:69), further highlighting that, “Many famished in holes and other poore cabbins in the ground” (*ibid.* p. 74). From residential quarters to activity-center domestic space, the proliferation of these “cabins in the ground,” by the 1620s and 30s, ranged from Martin’s Hundred (eight miles downriver from Jamestown) to Flowerdew Hundred (35 miles upriver from Jamestown). Each of these structures was uniquely situated in dimensions and use within its settlement context, though what connects them all is their appeal to the constancy of below ground temperatures. For the relationship between body and external temperature, such a concern for constancy meant mitigation of extremes, a stable bodily constitution, and prevention of the English body's physical and cognitive deterioration.

Flowerdew Hundred:

Forty miles upriver from Jamestown’s bake oven, Flowerdew Hundred’s bakehouse (Figures 9 & 10), constructed 10 years later, illustrates continuity in this seventeenth-century thermal concern and strategy. As with Jamestown, negative-space created the volume that was the interior, covered by an A-frame roof supported by posts set directly in the ground (Hodges 2011). Though unlike Jamestown, the pit walls were circular in form and possessed a single dug-out wall oven. Writing in July of 1621, the

Figure 9 pictures archaeologist, Charley Hodges, excavating 44PG82, or Flowerdew Hundred "Bread Oven" *Photograph (Kiser 1986). **Figure 10** illustrates Flowerdew Hundred's bakeoven in a profile bisection view. Located at the center of the settlement, 44PG82 represents the earliest known European site at Flowerdew Hundred.

Virginia Company sent a series of "Instructions" to the Council of State in Virginia and Governor, Sir George Yeardley – at the time, owner of Flowerdew Hundred. Of this list, the nineteenth instruction ordered, "puplique bakehowses in everie burrough bee built with all speed and dilligence." (Deetz 1993:43; Virginia Company of London 1957:117). Analysis of the 44PG82 bake-oven (*see* figures 11, 12, 13, & 14) demonstrates the microclamatic effects of oven use and non-use in this building as parallel to those effects seen at Jamestown. The thermal qualities and strategic use of compact earth for high-intensity temperatures allowed occupants to work with contained heat in excess of 350 °F, while pushing interior radiant heat toward the ceiling. In its early seventeenth-century context, prior to quantitative measurement of temperature, activities requiring rigorous temperature control, like baking and metalworking, subjectively gauged degrees

of heat from qualities such as the color of coals and heated metals (Kuijpers 2012:143). Temperature was not thought of as a numeric scale, but rather a measurement of temperateness (*e.g. see* Bullock 1649; Councell of Virginia 1610; Smith 1612; Williams 1650), referring to a characterization of place relative to a moderate point between hot and cold.

For the English observer, this understood point was relative to "temperate" English climate, and embedded within the fear of temperature extremes. This fear, measured by experience of atypical degrees heat from the English perspective, was mitigated in strategies such as subterranean building, illustrated here. As used with the Jamestown structure, the Flowerdew Hundred BIM visualizations render this experience of temperature from the modern reference point of degrees Fahrenheit – an invention of the eighteenth century. Tacking back and forth between epistemologies of temperature allows these visualizations to communicate and connect modern reference to historical experience.

In addition to combating oven and summer heat, winter use created an interior microclimate suitable, and somewhat desirable, for working and dwelling within this cellar bakehouse. Heating gains from the oven in winter-use cater to a resultant temperature between 65 and 73°F (Figures 13 & 14), while temperatures drop below freezing above and outside the structure. Even with the bread oven not in use, Flowerdew Hundred's subterranean structure was both cooler in the summer and warmer in the winter – more so than most contemporaneous above ground structures (Figures 11 & 13).

Figures 11, 12, 13, & 14: Buildings Information Model (BIM) hypothetical above-ground / actual (as constructed) below-ground comparison of Flowerdew Hundred's bake oven facility (44PG82) under different conditions – heating and cooling [summer/winter extremes]. Top left and right (Figures 11 & 12) show oven in use during summer extremes, bottom left and right (Figures 13 & 14) show oven in use during winter extremes.

Temperature fluctuations were avoided, as interior space remained within a relatively constant balance between hot and cold, a quality described as “temperate” by early

modern English observers in Virginia. Through analyses such as these, one can begin to see how building type and climate were very much intertwined in early seventeenth-century Virginia, and play a particularly informative role in revealing how perceptions of body and perceptions of environment are intimately connected through dwelling spaces. A roughly contemporaneous pit structure was found nearby, in close proximity to a more substantial manor house set on stone foundations. This “very temporary pit dwelling,” perhaps unlike the bakehouse, appears to have been primarily residential in function and merely covered with a canvas or sail, as identified through the recovery of burned tenterhooks in the absence of a framed roof (Deetz 1993:39). Pit houses were used for variety of purposes throughout the early Chesapeake, though the thermal need to produce bread and preserve either root crops, alcohol, or the self appears to define this form more coherently in relation to the early modern concern for climate.

Martin’s Hundred:

Less than 10 miles down river from Jamestown, excavations have revealed a pit house contemporaneous with Flowerdew Hundred’s subterranean bakehouse. Referred to in its interpretation as a “cave house” (Hume 1982:341), the residential cellar at “Site A” of Martin’s Hundred best illustrates the seventeenth-century bodily concerns for temperature extremes. The BIM analysis (Figures 15, 16, 17, 18) of this structure shows a clear microclimatic division between low-lying cool, below-ground temperatures and the pocket of warm air above, creating a roughly 6' interior living space with a temperate resultant temperature of around 70 °F. Mirroring this effect during winter extremes

(Figure 15), the coolest air is confined to the top, above ground interior space of the structure.

First seen with the “cave house” of Martin’s Hundred, a standard depth of four feet is embraced in Chesapeake cellar houses in the decades to follow, though some have been found set several feet deeper. As far north as Plymouth (Deetz & Deetz 2001:179-80) and Philadelphia (Burns 2005:65), the seventeenth-century English sought below ground dwelling spaces for the inexpensive, durable, and thermal qualities. While the Martin’s Hundred pit house investigated here is unheated, later (*ca.* 50 years later) examples of this form almost always contain an internal fireplace, complete with brick lining. One such example includes Flowerdew Hundred’s site 92, representing a substantial third-quarter seventeenth-century pit house, set five or more feet into the ground, with evidence for a large brick chimney (Deetz 1993:61-4; Markell 1990).

Depth was one of the most important decisions in pit house construction. Gillman observes that, “The thermal efficiency of underground structures is due to the fact that, at some distance below the ground surface, the soil temperature remains constant year around. Although this distance and the actual temperature varies with the above ground climate, underground structures take advantage of constant soil temperature, in that less energy is required to maintain a stable temperature” (1987:542 *citing* Underground Space Center, University of Minnesota 1979). Many Chesapeake pit houses, such as “Site A” from Martin’s Hundred, reach the Tidewater region’s four foot depth, taking advantage of the more uniform annual temperature.

Figures 15, 16, 17, 18: Buildings Information Model (BIM) of Martin's Hundred "Cave House" under different conditions – heating and cooling [summer/winter extremes]. A Residential building, this structure had no archaeologically visible heating source.

Figure 15: The top image visualizes the building in winter extremes.

Figure 16: The middle image visualizes the building in summer extremes.

Figures 17 & 18: The bottom two images visualize the building in summer extremes, comparing the characteristics of the same volume if it were above ground.

*After Hume 1982:58-9

The Subterranean Summer Solution:

Thermal dynamics visualization of Martin's Hundred's 'cellar house' in the annual summer extremes of Tidewater, Virginia.

Hypothetical thermal dynamics visualization of the same building volume above-ground, in the annual summer extremes in the Tidewater of Virginia.

Chesapeake buildings were built and rebuilt over the course of the seventeenth century in many different ways. This period has often been characterized as a trial-and-error phase of British New World colonization, with experimentation in locally produced or locally manipulated Old World material culture (Graham *et. al* 2007). The European

built environment of the Chesapeake exemplifies this best of all, as locally appropriate architectural agreement slowly replaces high variation in building form by the end of the seventeenth century (Carson *et. al* 2008). Though transcending such practices, building with a concern for climate is apparent, as seen through Buildings Information Modeling. In early seventeenth-century accounts, “climate,” or “clime” was typically synonymous with *annual temperatures*. Building for climate, to the “temperate” English body, was therefore a concern for the extremes, as the pit house from Martin’s Hundred illustrates well the balance between hot and cold desired within an environment experienced through the balance of bodily humors.

Discussion:

In this study, I have emphasized the consideration of epistemology in both seventeenth-century experience and twenty-first century interpretation. As much as “ways of knowing” vary in the recent past, the same is particularly true for modern investigation. As one way of knowing, this paper has hopefully cut against research that situates structures as either a social or physical milieu, with little room to approach the two in dual consideration. Bridging such either or portrayals, I also hope that this paper has reoriented the common tendency to equate the environmental aspects of a building to materials alone. Such an assumption, in turn, confines the role of the environment solely to the material construction of a building, as opposed to the daily interactions between weather, buildings, and individuals dwelling within constructed space. Exceptions certainly exist, though are few in number in the Chesapeake region (*e.g.* Linebaugh 1994; Rockman 2010).

Buildings, in their most fundamental role, are shelter – a human necessity. A dwelling is the creation of a place, differentiated from the surrounding space in some meaningful way. This paper has demonstrated how domestic structure creates a place that does not remove one from the elements, but establishes a relationship to them that is embedded in historically-situated understandings of the environment. This relationship differs epistemologically from most constructed spaces of today; as such elements of the early-seventeenth century include air, earth, fire, and water – each having a substance, a material nature, a physical reality. Transcending time, by design, local innovation, and borrowed strategy, a building represents a relationship to place in that it is responsive to local temperature, humidity, weather patterns, etc. Such a role in the creation and manipulation of a climate within a climate (*i.e.* physical microclimate) both rivals and complements the need to create and manipulate a socialized space within a society (*i.e.* social microcosm). Dwellings, it is argued here, should be understood as the negotiation between the two.

Much of the contemporary use of dwellings within historical archaeology has reduced standing buildings to floor plans, effectively deconstructing built environments to a comfortable level of fragmentation for the historical archaeologist, and encompassed within a larger comparative sample of excavated foundations. While the study of floor plans has proven highly productive, much is uncritically left to supplement the constraints of walls and thresholds alone. Much of this form of archaeology frames space in isolation, understanding distance, proximity, dimension, and area as unifying variables of landscape. Though one must ask, ‘to what end?’ Such comparatives give the discipline a bird’s-eye-view of sites and a means to wide-coverage survey, though one that filters

interpretation through a finite number of narratives. A few of these can be described as dynamics of resource use, social segregation and integration, horizontal organization of society, economic labor strategies, and the correlation of social position with area and proximity. While these overarching themes can give rise to a much larger number of particular narratives when applied more generally, it has proven exclusive to the breadth of cultural resources at the archaeologist's disposal. This study seeks to deviate from these conventions.

Spatial segregation is not the only boundary of social difference within any given society – past or present. It is perhaps the most archaeologically apparent signature, though one that relies upon visibility alone. As a dwelling is constructed specifically to shelter social activities, much is sacrificed by neglecting a building's role as an environment for human lives. Environmental considerations and the study of human-environment interactions have seen relatively little attention in historical archaeology. With the rise of a number of critiques, many archaeologists have tended to distance themselves from environmental considerations with hesitation towards functionalist-notations, or their work being read as environmentally deterministic. The product of this trend has been the outright "neglect" of environmental considerations (Robb 2004:3). What has not been acknowledged is that the manipulation of the local environment through the built environment, in the way of microclimate creation, arguably caters to an equally social, as much as it does functional, interpretation. In many dynamic ways, historic buildings accommodate socially influenced degrees of physical comfort – through the manipulation and allocation of heat, coolness, and even odors – in many ways similar to the social segregation of varying degrees of aesthetic craftsmanship,

room accessibility, and the surveillance of space. Of equal significance here, in light of modern concerns, are the ways in which individuals work both with and against the local environment they inhabit through ways of knowing natural phenomena such as the nature of heat and earth in the early-seventeenth century. As demonstrated in this study, historical epistemology offers one significant avenue for the study of human-environment interaction within historical archaeology. Such questions call for new interpretive frameworks and methods of spatial analysis that extend beyond, or perhaps *above and below*, ground surfaces.

From this, it is easily argued that most archaeological studies of landscapes and the built environment have overly-relied upon visual experience alone. Similar arguments have been made for approaches to cultural landscape studies (Upton 1997). From phenomenological study (Tilley 1994) to the methodological toolkit of GIS (Conolly & Lake 2006), much of the pursuit of the human condition has typically equated to the visual human condition. Though as demonstrated in the preceding pages, the analysis of air, or the "medium" (Ingold 2011:22-24) through which one lives, provides new avenues of archaeological investigation of past experience.

Conclusions

In his recent book on architectural space, Matthew Johnson notes, "The one true end of the study of old houses is to understand something of the ways of life and system of thought of their builders, owners and users" (2010:3). Here, I have attempted to build upon this notion, though refine a more general understanding of "the ways of life and system of thought" (*ibid.*) beyond social relations as an isolated narrative of

archaeological significance. Intended quite literally, the past does not exist within a vacuum. People respond to the regional conditions of the places they call home, and dwell *through* a particular way of knowing the world. Prior to the second quarter of the twentieth century, with the wide scale mechanization of internal heating and cooling, buildings worked to shape the environment, rather than combat it as they do now. Buildings were something fundamentally different in many ways. A consideration of historical epistemologies in the context of shaping the material world allows historical archaeology to enter the conversation of the history and philosophy of science and technology in meaningful ways.

The scope of this paper did not permit a robust discussion of seventeenth-century science as it emerged from Natural Philosophy, though as this study has evolved it is relevant here to engage this conversation. The history of science is often given definitive dates, though the reverberations of this knowledge to a wider epistemology are typically less clear and unspoken. This paper helps illustrate how despite the ongoing Scientific Revolution in Western Europe, little of the scientific knowledge was disseminated to the wider populace, let alone accessible. It is important to see this relationship within this period of transformation from a medieval world to a post-medieval world, as a many “medieval” beliefs persisted through the nineteenth century, as with the case of bodily humors. To this end, the history of science and technology differs radically when told through a material record, reorienting knowledge of the world to everyday practice.

Fundamental to historical archaeology, as explored here, is the use of multiple records, and particularly archaeological and documentary records. With few orthodox guidelines as to the way in which these two records are used in tandem, such a

relationship points to historical archaeology's strengths, specifically in that documents and material evidence are drawn upon in different ways to reach different ends. Russell Barber reminds us that "Each presents its own unique inputs, each has its gaps, and each can be distorted by a variety of factors" (1994:42). Here, I have used documents as an input to reach historical epistemology of the early seventeenth-century British Atlantic, allowing me to see the relationship between knowledge embedded in present investigation/interpretation, and knowledge of natural phenomena (*e.g.* heat, air, human anatomy) in the past. Through archaeology, I have explored a particular way of knowing the world in the specific context of the dweller, shedding light on how ideas of the body, and its relationship to the "weather-world" shape the multifaceted ways in which people construct and dwell within a particular place. Further, this research program provides access to the ways in which such knowledge was, and is, used to construct a material world in relation to the body, and more importantly, in relation to a particular conception of the body. Chesapeake pit houses are only one such example investigated here, situated within the *a priori* acceptance of bodily humors and larger Aristotelian world view through which built environments were created and experienced. This paper illustrates the importance of viewing built environments within contextually situated epistemologies (including those in the present), and the ways in which a particular knowledge of the world shapes the ways in which one dwells within it. In the context of New World colonization, Old World epistemologies were extended to confront the knowledge of new places. Colonial landscapes both shaped, and were shaped by, ways of knowing the world unique to time and place. Historical archaeology has much to gain from further

integration of historical epistemologies, situating knowledge in the past and knowledge in the present within active contexts.

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